

GEOLOGY OF THE DRY CANYON AREA

Senior Thesis

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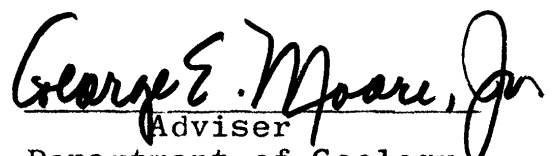

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GEOLOGY OF THE DRY CANYON AREA

INTRODUCTION

For the past twenty or so years the Geology Department of the Ohio State University has conducted summer field courses in Central Utah, with field headquarters at Snow College, Ephraim, where geology senior or advanced students get the opportunity to have their first real field experience. In the summer of 1970 I was one of the students who had the opportunity to go to Ephraim, in the vicinity of which party areas are assigned to the participants of the program. The Dry Canyon area is located approximately six miles due west of Snow College, and is on the west side of Sanpete Valley. It is an area of about 16 square miles, being bounded on the east by said Sanpete Valley; on the north by Horse Mountain; on the south by Maple Canyon; and on the west by an imaginary line passing through South Bald Mountain. Dry Canyon and Rock Canyon are the two major canyons in the area. In the walls of Dry Canyon Area are exposed all the formations that can be mapped in this area. As in other parts of Central Utah the Dry Canyon area is marked by high reliefs and prominent features. Most of the canyon walls range from 100 to 400 feet in height, with excellent exposures of the bed rocks, nearly all of which are sedimentary. Vegetation is sparse

in the area, except for the few juniper trees.

The Dry Canyon area, as part of the whole Central Utah region, has received the attention of both many professional geologists and student geologists. Consequently, while it is not possible for the present paper to discuss the investigations and findings of these people individually in any way, it is worth mentioning here that all of these people now agree that the rock units in this area are certainly Late Mesozoic to Early Cenozoic in age, and that they were deposited in fluvial, marine, or lacustrine environment in which there have been several episodes of orogenic activities.

The present work is therefore merely an attempt to shed some light on the facts presented by previous workers and to make some effort at an interpretation of the Dry Canyon Area as observed and worked out by the writer.

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I am greatly indebted to my field partners, Jeffery Cox and Ronald DeHaas, who were unbelievably very willing to discuss, and sometimes explain, any problem that I did not understand. Special thanks also go to my thesis advisor, Dr. George E. Moore, whose advice and aids during the writing phase of this work were of tremendous help to me. I must thank each and everyone of my departmental professors, especially my advisor, Dr. Fleck, for whatever contribution they have made toward my preparation. Finally my deepest thanks go to AID of the U. S. STATE DEPARTMENT for the scholarship given me.

STRATIGRAPHY

General Statement

The Dry Canyon Area is a region of highly excellent exposures of sedimentary rocks and is one of the most complex areas around the Sanpete Valley.

The rocks exposed in this area range in age from Late Jurassic to Eocene. The formations include the Twist Gulch, Indianola, North Horn, Flagstaff, Colton, and Green River. Except for the Green River Formation, which contains thin interbeds of tuff, all of the formations are of sedimentary origin, and are composed chiefly of clastics and carbonates.

The Twist Gulch Formation is marine; the remaining formations were deposited in fluvial and lacustrine environments. These formations were identified on the basis of lithologic character and stratigraphic position. The total thickness of these formations in the area (measured in different sections) is approximately 3600 feet (see stratigraphic section).

The Jurassic System

Twist Gulch Formation

Definition: The Twist Gulch Formation was formerly considered to be the upper member of the Arapien Formation of Central Utah (Spieker, 1946, p. 124) but was later raised

to formational status by William N. Gilliland (1951, p. 108). Its type locality is on the north-side of Saline Canyon above Twist Gulch, Sevier County, Utah.

Description: At the type locality, the formation is composed of thinly-bedded dark-red to chocolate sandstone, siltstone, and shale. This general description is also applicable to the formation in the Dry Canyon Area. However, the formation appears here as an interbedded succession, predominately of siltstone, mudstone, and sandstone. Most of the beds are red, though there are many gray to green strata; the beds are moderately uniform in thickness. Cross-bedding is found in some of the sandstone units locally, but in general is of little use because these friable units weather rapidly.

Distribution and Thickness: The formation is widespread and fairly consistent in occurrence especially around the Ephraim, Utah area. Previous workers in the Central Utah region give the thickness of the formation as 3000 feet. In the Dry Canyon Area most of it is covered with heavy rubble except its exposure on the south-facing wall of, and near the mouth of, Dry Canyon, where it underlies the North Horn Formation in angular unconformity. In addition, the formation crops out in Confusion Gulch, just south of Dry Canyon. Because of these scattered exposures and poor outcrops of the formation it was difficult to determine the total thickness. The base of the formation is not exposed in the area, neither is the top. However, the thickness of that part of the formation exposed in the area is 300 feet.

Age and Correlation: The presence of certain fossils, such as Ostrea strigilecula, White, VolSELLa subimbricata, Meek, has led to the correlation of the formation with the Carmel Formation of the San Rafael Group, which is at least Upper Cretaceous in age (Spieker, 1946, p. 125).

The Cretaceous System

The Indianola Group

Definition: The Indianola Group, whose type locality is in the Indianola District, Utah is Upper Cretaceous in age. When Spieker (1949, p. 20) defined the group, he divided it into four members: the Sanpete, the Allen Valley Shale, the Funk Valley, and the Six Mile Canyon. In the Dry Canyon Area, this group cannot be divided.

Description: At the type locality, the group has been described as a thick massive coarse clastic unit, most of which was dumped from nearby mountains into a geosynclinal depression that extended across the eastern margin of the mountains (Spieker, 1949, p. 20). In the Dry Canyon area, the group was recognized in one place only, and even at this place, in Confusion Gulch south of Dry Canyon, the group is poorly exposed in a fault zone where it has been thrust against the North Horn Formation. These beds are marine clastic sediments composed mostly of tan conglomerates with silty to sandy matrix and calcareous cement. The pebbles, which are about an inch in diameter, are mostly rounded to subangular in shape and are 60 to 70 per cent quartz in composition. Fossiliferous limestone, buff sandstone, and chert make up the other

30 to 40 per cent.

Distribution and Thickness: The group is one of the well-known Upper Cretaceous rock units in Central Utah. At least one of its members crops out in the Cedar Hills, Hjuk Creek, Thistle, Indianola, Sixmile, and Saline Districts. However, its best exposures are in the northern part of the Gunnison Plateau, in the Cedar Hills, and in Chicken Creek east of Levan. The total thickness of the group in the Central Utah region is about 7150 feet (Spieker, 1946, p. 122). In the Dry Canyon Area that part of the group exposed has a thickness of 95 to 100 feet.

Age and Correlation: The Indianola Group has been correlated with parts of the Nancos shale on a palentological basis. Fossil evidence indicates that the group lies between Colorado and Montana in age.

The Cretaceous and Tertiary Systems

The North Horn Formation

Definition: The North Horn Formation, originally identified as the lower member of the Wasatch Formation in Central Utah; was named and described by E. M. Spieker (1946, p. 132). It was named after North Horn Mountain (Ts. 8 and 19S; R. 6E; Salt Lake Meridian), which is the type locality. It is Late Cretaceous and Early Paleocene in age.

Description: As a whole the North Horn Formation is one of the most interesting and problematic rock units in the

Central Utah region. Its thickness and lithologic characteristics vary considerably from place to place. However, at the type locality the formation is mainly composed of variegated shale and sandstone, conglomerate, and fresh-water limestone. In general, the formation is considered as representing an alternation between fluvial and lacustrine conditions. Irregular bedding, graded bedding, and fair sorting are proofs of these origins. Most of the limestone has clastic texture, and is gray to reddish-gray; the shale is commonly sandy and calcareous; the sandstone is medium-to fine-grained; and the conglomerate is composed mostly of rounded quartz pebbles that have average diameters of about 1 to 4 inches, and few pebbles of chert and flint.

In the Dry Canyon Area, the formation is composed principally of less resistant units such as dark reddish-chocolate mudstone and thinly-bedded siltstone, both of which are evenly bedded but by no means compact, especially toward the top. The base of the formation is composed of well-cemented poorly-sorted calcareous conglomerate composed of quartz pebbles and abundant oncolites as much as eighteen inches in diameter. The oncolites have a concentric structure, and most of them have a fossil mollusc as a seed around which the oncolite has grown through agitation of water currents. The oncolites are generally concentrated at the base of the conglomerate, which grades upward into poorly-sorted friable sandstone that show little cross-bedding. Some of the sandstone units show characteristics that are strongly suggestive of channel

origin; graded bedding is not generally apparent. The beds are generally thin to medium bedded and yield to weathering processes easily; during weathering they lose the common characteristic gray color and most of them become reddish-yellow.

Distribution and Thickness: Few formations in the Central Utah region surpass the North Horn Formation in distribution. It is the most outstanding formation in the western half of the Wasatch Plateau and the southern part of the Gunnison Plateau. It equally-well dominates other formations in the Valley Mountains, and in the Pavant Range and Long Ridge west of Juab Valley. The thickness of the formation varies widely in the region. For example, in lower Saline Canyon its total thickness is about 500 feet, whereas it attains a total thickness of 9000 feet in the Cedar Hills. In general, the formation thickens northwards, and its gross thickness lies between 500 and 9000 feet (Spieker, 1949, p. 26).

In the Dry Canyon Area, the North Horn Formation is exposed very excellently in three places. These three places are: (1)The south-facing wall of Horse Mountain, (2)Near the mouth of Dry Canyon on the East-facing wall of Sanpete Valley, and (3)The south-facing wall of Confusion Gulch. At other places in the area its less resistant nature makes it appear as rubble on the canyon walls. In some places, however, loose blocks of conglomerate from the basal portion appear to be in place, when in fact they are slump or torera blocks. The average thickness of the exposed portion of the

formation in the area is about 186 feet.

Age and Correlation: Proof for the age of the North Horn Formation is found in two groups of fossils. The first of these is the dinosaurian remains (with some questionable fossils of fresh water molluscs) that are found in the lower half of the formation and provide evidence that that half is most probably Late Cretaceous. The second group is the mammalian remains that are found in the upper half of the formation, proving that portion to be Early Tertiary (Paleocene). These fossils indicate that the North Horn is correlative with the Lance and Fort Union Formations of the northern plains and with the Ojo Alamo, Puerco, and Torrejon Formations of the San Juan Basin.

The Tertiary System

The Flagstaff Formation

Definition: Because of its highly resistant nature to the forces of weathering, the Flagstaff Formation appears to be the best known formation in Central Utah. Originally this formation was designated as the middle member of the Wasatch Formation of Central Utah (Reside and Spieker, 1925, p. 448-449) but it was later given formational status and described by E. M. Spieker (1946). This formation, with its type section on the slopes of Flagstaff Peak, Sanpete County, Utah, is Late Paleocene to Early Eocene in age.

Description of the Formation: The formation is composed

chiefly of white or cream limestone, though locally it contains interbedded gray shale, minor amounts of sandstone, gypsum, oil shale, volcanic ash, and coal. In some places such as the Wasatch Plateau, its beautiful outcrops not only attract the attention of geologists but also that of non-geologists. Its fossil contents and lithologic characteristics clearly indicate that this formation was deposited in a lacustrine environment.

Commonly the limestone is medium-grained and appears in three types: dark gray and charged with fossils; dark gray, massive, relatively unfossiliferous; and cream to light tan. Algal limestone is abundant. In some places the limestone is silicified; chert beds and nodules are also abundant (Spieker, 1949, pp. 30-31). Beds are commonly massive, and the formation becomes more clastic towards the west.

With minor exceptions the foregoing general lithologic descriptions also hold for the formation in the Dry Canyon Area. In this area, the formation contains far more less-resistant interbedded units such as mudstone and siltstone. Dolomite units are also common. A few interbeds of marl with fossil gastropods and pelecypods are present. Most of the strata, notably those three limestone bands along Dry Canyon, are massive and quite continuous. Some of the sandstone units are of channel origin. Calcite and aragonite crystals can be found in some of the beds, especially along fault planes.

Distribution and Thickness: The Flagstaff Formation is

one of the most extensive stratigraphic units in Central Utah. It is known to be present throughout the Wasatch Plateau and it extends for unknown distances in almost all directions. It forms the white cliffs that are responsible for the unique scenic features in the plateau. It is also prominent in the Gunnison Plateau, capping the main frontal escarpment on the east side of the plateau, and is likewise outstanding, though presenting different lithologic aspects, in the Valley Mountains, the Long Ridge, and the Pavant Range. In all of these localities it does not only maintain its prominence, but also its regional persistence and general consistency. The formation shows great variation in thickness throughout the area. For example, in the Wasatch Plateau it has thickness of 200 feet in some places, whereas it attains a thickness of 1,500 feet in some places in the southern part of the plateau (Spieker, 1946, p. 136).

In the Dry Canyon Area, the formation is exposed in three great bands along the Canyon. These bands form the white prominent cliffs. In no other place in the area is it as prominent except perhaps in Confusion Gulch. It has thickness of about 500 feet.

Age and Correlation: Spieker (1946, p. 136) pointed out that even though there was uncertainty as to the true age of the formation, the presence of fresh-water gastropod and pelecypod fossils in it indicated that the Flagstaff Formation is more Paleocene than lower Eocene. He, however, assigned a Late Paleocene-to-Early Eocene age to the formation. In a later

work La Rocque (1960, p. 74) shows that the formation is correlatable with the Tongue River Member of the Fort Union Formation, thus agreeing with Spieker as to the age of the formation.

The Colton Formation

Definition: The Colton Formation, formerly the upper member of the Wasatch Formation of central Utah, was raised to a formational rank by Spieker (1946, p. 136). The type section is to the north of the village of Colton, Utah. It comprises the strata lying between the Flagstaff Formation and the Green River Formation. The age of the formation is Early Eocene. This age is only provisional because no diagnostic vertebrate fossils have been found in the formation to prove or disprove this conclusion (Spieker, 1946, p. 34).

Description: The formation is predominately clastic. It is floodplain and channel in origin and comprises mostly sandstone and shale; but a few strata of limestone, mudstone, and siltstone are found locally. Bedding is principally irregular and discontinuous. Its characteristic bright colors, displayed in shades of red, pink, and bluish-gray, make its distinction from the enclosing strata normally easy. The limestone units are mostly lithographic to fine-grained and argillaceous. The sandstones are ordinarily brown or light brown and are generally friable; the beds range from five to thirty feet in thickness.

The formation in the Dry Canyon Area is composed of

varigated sandstone, mudstone, siltstone, and limestone. The sandstones are medium to fine-grained, locally micaceous, and well sorted. These sandstones are generally continuous and were used as marker beds very successfully. Commonly they are red, but appear yellow because of weathering. Most of the mudstone units are blue to gray, and calcareous. They show fair to good bedding. The limestone strata are generally fossiliferous, gray to light blue, and they commonly grade into very fossiliferous mudstone or siltstones.

Distribution and Thickness: The Colton is restricted to the northern and western margins of the Wasatch Plateau, the main body of the Gunnison Plateau, and the southern margin of the Valley Mountains. In some places, such as the northwestern portion of the Wasatch Plateau and the north central part of the Gunnison Plateau near Freedom, Utah, it is almost absent because of intertonguing with the Green River Formation.

The formation generally ranges between 300 and 1000 feet in thickness, even though in places as on the west flank of the Wasatch Plateau and the West Travaputs Plateau it may be as much as 1600 feet thick, and it becomes very thin in places like lower Salina Canyon (Spieker, 1949, p. 34).

In the Dry Canyon Area, the formation is more extensively exposed than any other formation, although it is by no means conspicuous because of its lithologic composition, which yields to weathering easily. It also surpasses all other formations in the area in thickness, having a thickness of about 1000 feet.

Age and Correlation: Spieker (1949), using fossil mollusks, gives Early Eocene as the probable age of the formation. Its correlation with any other formation is uncertain; however, it seems logical to state that it is in part equivalent to Green River because it intertongues with that formation.

The Green River Formation

Definition: This formation was originally named and described by Hayden (1869, p. 90). The type section is at the town of Green River, Sweet Water County, Wyoming. The formation is lacustrine in origin, and it is of Middle Eocene age. In central Utah, the Green River is composed of the strata that lie between the Colton Formation and the Crazy Hollow Formation.

Description: The formation is characterized by various lithological facies which include limestone, shale, dolomitic marlstone, shale, some with salt crystal molds, algal deposits, oolitic limestone, and tuff. Limy sandstones are also found locally. The beds of tuff are moderately persistent and are good marker beds, especially in the Sanpete Valley and vicinity (Spieker, 1949, p. 35). The oolitic beds are in the upper portion of the formation. In the lower part, the tuff alternates with mudstone, shale, and limestone; in the upper part it alternates with marlstone toward the oolitic bed. It contains substantial amounts of fossils including molluscs, plants, fish, fly larvae, birds, mammals and reptilian bones.

Principally the beds are light gray, blue, or tan. In the Sanpete Valley and environs the strata are less massive but fairly continuous.

The formation shows nearly all the foregoing lithologic characteristics in the Dry Canyon Area. In this area, the basal part is light-gray to bluish-green limestone and the top part is a somewhat massive unit of the same rock type. Between these two units the formation is composed of alternating beds of mudstone, shale, limestone, siltstone, and about nine lenses of tuff. Most of these strata are less resistant, but continuous. Locally they contain freshwater fossil mollusk fragments, and algal heads that are chiefly found at the base of the upper limestone unit.

Distribution and Thickness: There are only a few places where the formation is well exposed. These places include the northern and western base of the Wasatch Plateau and the upper levels of the Gunnison Plateau. It is only locally exposed in other places such as the base of the Valley Mountains and the Pavant Range in the vicinity of Round Valley. It also occurs along the outer flank of the Wasatch Monocline. (Spieker, 1946, p. 34). It is even more limited in extent in the Dry Canyon Area. In this area its only excellent exposure is at the head of Dry Canyon (sec. 25, T.16S., R. 2 E., Manti Quadrangle).

According to Spieker (1949, p. 35), the average maximum thickness of the formation in central Utah is about 6000 feet, especially north of the Wasatch Plateau. In the Dry Canyon

Area the total thickness of the exposed part of this formation is about 966 feet as measured in the section cited in the preceeding paragraph.

Age and Correlation: Fossils of mollusks, reptiles, birds, and mammals prove that this formation is Middle Eocene in age (Bradley, 1964, p. A28). It has not been correlated with any other formation.

STRUCTURAL GEOLOGY

Regional Structure

Although the structural geology of central Utah is surpassed in complexity and diversity by few other parts of the country, it is essentially expressed in three major structural features. These features are (1)The Gunnison Plateau, (2)The Wasatch Plateau, and (3)The Sanpete-Sevier Valley. The Wasatch Plateau forms the westernmost extent of the great Colorado Plateau Province and has a general southwest-to-northeast trend; at its junction with the Sanpete Valley, at its western boundary, the plateau forms a prominent west-dipping monocline called the Wasatch Monocline. Next west is the Sanpete-Sevier Valley, which is slightly sinous and trends almost north-south for 65 to 70 miles. Sanpete Valley is underlain by an anticline that has a structural relief of about 20,000 feet, (Gilliland, 1963, p. 115), but unfortunately this high relief is almost unnoticeable because the valley has been filled with alluvium and colluvium. To the west of the valley is the Gunnison Plateau, which is composed chiefly of faulted and gently folded rocks of Cretaceous and Early Tertiary age (Gilliland, 1948, p. 112).

Local Structure

General Statement: The Dry Canyon Area is marked by several faults, one large graben, folds, and at least one angular unconformity. Most of the faults, with the possible exception of some along Rock Canyon, are exposed clearly. The folds are clearly expressed in certain localities in Dry Canyon and Rock Canyon (secs. 29 and 32, T.16S., R. 2 E.). The unconformity lies between the North Horn and Twist Gulch, and is quite noticeable near the mouth of Dry Canyon, especially along the dirt road that passes through section 33, T.16S., R. 2 E. and goes to the back-country.

Folds: The largest fold revealed by the rocks of the Dry Canyon Area is the Sanpete-Sevier Valley anticline; the rocks of the Dry Canyon Area are on the west limb of the anticline. As should be expected, the attitudes of the beds are controlled by this anticline, which trends north. Thus the general trend of the strata is north; their dip, to the west decreases rapidly westward. Indeed, one can infer the presence of a syncline, probably a major one, further west, which affected only pre-Price River formations in the area. However, faulting and local movements have caused variation in the general change in angle of dip.

Because of extensive erosion which has resulted in the valley, and later filling by alluvium, the axis of the major fold is not exposed. However, from studies of the structures of nearby exposures it can be inferred that the anticline

plunges south.

It has been postulated that the anticline, which is really a fan fold, resulted from a compression during the early Laramide orogeny (Gilliland, 1963, p.). It is possible that as this compression continued, and with rapid erosion taking place at the crest, the upper-most strata, including the soft Arapien shale, were removed. In fact, Gilliland (1963) thinks that after its exposure, more of the mobile Arapien continuously flowed to the axis with subsequent periods of compression. The outward flowage of this plastic-like material (the Arapien) may have been responsible for the overturn of the immediate overlying strata, which might not have been well consolidated at the time.

On the west limb of the Sanpete-Sevier anticline is a smaller fold that has the shape of the letter S as viewed from the south. It is asymmetrical and tight, and in general its bends are sharp. The amplitude of this fold is about 400 feet. The fold is well exposed in the Flagstaff Formation on the north wall of Dry Canyon ($NE\frac{1}{2}$ $NW\frac{1}{2}$ Sec. 4, T.16S., R.2E.). It trends nearly north. Some of the beds involved are overturned and may have local dips as high as 82 degrees to the east. This fold is also attributed to a Tertiary compression. According to the attitude of the flexure, the compression was directed from the east. The sharp bends in the fold would indicate that at the time of this compression the Flagstaff Formation was in a semi-consolidated condition, which allowed it to yield plastically.

There are also two minor but interesting folds exposed in the Twist Gulch Formation in Confusion Gulch south of Dry Canyon. These minor folds plunge to the south, are overturned, and the axial planes of the folds dip, on the average, 33 degrees SE. The folds are tight and have average amplitudes of about five feet at the mine adit where they are beautifully exposed. These folds might have a compressional origin similar to that of the fold discussed in the preceeding paragraph.

The direction of the dip of the younger strata in the Dry Canyon Area indicates the presence of a shallow syncline under the Gunnison Plateau. In the western part of the area, the Colton and Green River Formations, both Tertiary, dip westerly at angles of 3 to 5 degrees. These beds, therefore, are on the east limb of the shallow syncline. This shallow syncline is shown by Price River, North Horn, Flagstaff, Colton, and Green River beds, all of which are Upper Cretaceous and Tertiary in age. It plunges south, with Upper Green River almost horizontal.

Faults: The major fault in the area is the Gunnison Front Fault, which lies buried under the alluvium in the Sanpete Valley. It can be recognized on air photographs by the streak-like alluvium sediment which follows the trend of the fault throughout most of the valley. It trends approximately N.20E. (sec. 2, T.17S., R.2E., and secs. 25, 26, 35, T. 16S. R.2E.). This fault is about vertical and is downthrown to the east. It has a displacement of about

2400 feet. According to Hunt (1956, p. 52) the fault may be regarded as a northward extension of the Sevier Fault.

Next in importance among the faults in the area are two faults that border the Dry Canyon graben (sec. 5, T.17S., R.2E.). The northern boundary fault of the graben trends almost west; its vertical separation is about 520 feet, and it is downthrown to the south (secs. 5,6, T.16S., R.2E.). The southern boundary fault closely parallels the northern fault in sec. 4, T.17S., R.2E.; in sec. 5, T.17S., R.2E. it strikes about N.70W.; and sec. 6, T.17S., R.2E., it strikes about N.85W. It is downthrown to the north. The vertical separation is nearly 800 feet.

The origin of the graben can be explained in the following way: From the variation in thickness of both North Horn and Flagstaff it is possible to imagine a local high on the pre-North Horn unconformity in the area, for both of these formations, though massive and compacted, are thinner in the graben than they are to both north and south. Consequently they were prone to faulting as a result of the tension thus set up.

Several other faults also deserve mention here. Two minor faults that strike about east and are associated with the graben area exposed in SW $\frac{1}{4}$ sec. 4, T. 17S. R2E. These faults are best seen in the Flagstaff Formation; each has a vertical displacement of less than 20 feet and both are branches of a short fault that extends into the North Horn formation. Their origin is also related to the graben. The down-thrown blocks on both faults are to the south. There are other minor faults in NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 4; center of sec. 33; and NE $\frac{1}{4}$ sec. 33, T. 16S R2E. These

appear to be gravity faults.

In addition to the graben and the gravity faults, there are two thrust faults in the area. Along one of these Twist Gulch is thrust over North Horn (secs. 28, 33, T.16S., R.2E.) at high angles; this thrust dips to the east. The second thrust in the southern part of section 4, T.17S., R.2E., involves Indianola and Twist Gulch. Here Indianola is thrust over Twist Gulch along a thrust that dips about 48°E .

Unconformity: A prominent angular unconformity separates the North Horn (Paleocene) from the Twist Gulch (Jurassic). It is excellently exposed on the north side of the dirt road (secs. 4 and 33, T.16S., R.2E.) that goes to Rock Canyon and the back country. Here the Twist Gulch beds, overturned and dipping 38°E ., are overlain by the basal conglomeratic beds of North Horn, which dip about 82° to the west. At this place, the strata of Indianola and Price River Formations are absent.

GEOMORPHOLOGY

The Gunnison front is marked by several minor alluvial fans. The sediments in these fans are generally red due to the predominance of Twist Gulch which, because of its soft nature, is easily and greatly affected by the slope wash. Flash floods are not uncommon in central Utah, which explains the presence of local boulders in the fans. Most of the boulders are from local formations--moderately resistant North Horn and Flagstaff. The average size of these boulders is about three feet in diameter, and there is little sorting due to the short distance from the slopes to the valleys. The fans also contain abundant gravels.

Mass movement in the area is indicated by toreva blocks along the Sanpete Valley. Most of these blocks are from Flagstaff or North Horn. The only geomorphic feature that the writer intends considering as a fault scarp is that scarp parallel to the large graben mentioned earlier. There are certainly many erosional surfaces in the Dry Canyon Area, but the writer would prefer not calling them sediment surfaces.

ECONOMIC GEOLOGY

The rocks in the Dry Canyon Area have, as yet, little or no economic value. There are mine adits in the area, but it seems that they are merely for exploratory purposes and probably do not show any evidence of the presence of any mineable minerals in the rocks. As recent as the time of our work in the area, a geophysical team was conducting another set of exploratory tests, the result of which are not yet available, at least to the writer.

GEOLOGIC HISTORY

The history recorded in the rocks of Dry Canyon in particular, and in the Sanpete Valley Area as a whole, begins in Jurassic. During this time the Twist Gulch Formation was deposited. The inconspicuous cross-bedding and moderate sorting in the sandstones, and the even bedding, suggest that the formation was deposited in a marine environment. The presence of evaporites such as gypsum and halite, however, indicates that there were times of periodic dry climates which facilitated the creation of local closed basins in which the evaporites accumulated.

Late in the Cretaceous, after the deposition of the Morrison?

Formation, which is not present in the Dry Canyon Area, the Indianola Group was deposited. The group, by virtue of its diversified lithologic composition, indicates a depositional environment characterized by oscillating marine, and continental transitional conditions. For example, the poorly sorted sandstone and conglomerates of the Six Mile Formation, the lowest member formation, show that this particular member was deposited in a high energy fluvial environment, whereas the Allen Valley shale indicates a marine, relatively quiet, condition.

Then sometime in Upper Cretaceous there was an anticlinal uplift at the site of the present-day Sanpete Valley; the anticline trended north-northeast with the western limb slightly overturned to the west. This uplift affected both Twist Gulch and Indianola. The high relief, due in part to folding, but also to erosion, possibly followed by a period of non-deposition, may also explain the absence of Price River Formation and the presence of the unconformity between Twist Gulch and North Horn in the Dry Canyon Area. The lower part of North Horn Formation in the study area was deposited upon the angular unconformity in an environment that seems to have been a low area during Early Paleocene. This lower portion of the formation, consisting mostly of conglomerates and sandstone, probably had the anticlinal uplift as its source of sediments. The upper limy part of the formation suggests the evolution of a lacustrine or shallow water environment. It would seem that the deposition was accompanied by localized but continual uplift which

dictated the small thickness of the formation in the area.

However, during the time interval between Late Paleocene and Upper Eocene widespread lacustrine conditions prevailed in the area. At this time the Flagstaff limestone was deposited.

This lacustrine environment, nevertheless, seems to have had a geologically short duration. It was followed by another fluvial environment, with possibly interdistributary bays, in which the Colton Formations was deposited in Eocene. Evidence for this change rests in the presence of a few cross-bedded channel sandstone in the Dry Canyon Area.

The fossils in the Eocene limestones and mudstones of Green River Formation shows that the formation was deposited in a fresh water lake environment. The presence of rhyolitic tuff in this formation points out the periodic existence of some high local points, such as islands, in the area where occasional volcanic eruptions occurred or the presence of volcanoes in a nearby place from which the tuff was transported into the area.

The gentle syncline under the Gunnison Plateau is attributed to a set of compressional forces from the east just after the deposition of the Green River Formation. The set of compressional forces that produced this syncline possibly originated from the Wasatch monoclinal flexing or uplift; tension forces during the late stages of this period of activity might have caused the gravity faults, such as the Gunnison Front Fault.

The Gunnison Plateau uplift was the next event in the Central Utah region that affected the Dry Canyon Area. This uplift, which was post-Green River, was accompanied by the formation of

the grabens in the Dry Canyon Area.

The geological history of the area under study closes with Quaternary erosion to produce the valleys, landsliding, and alluvium-colluvium deposition as observed today.

STRATIGRAPHIC SECTION

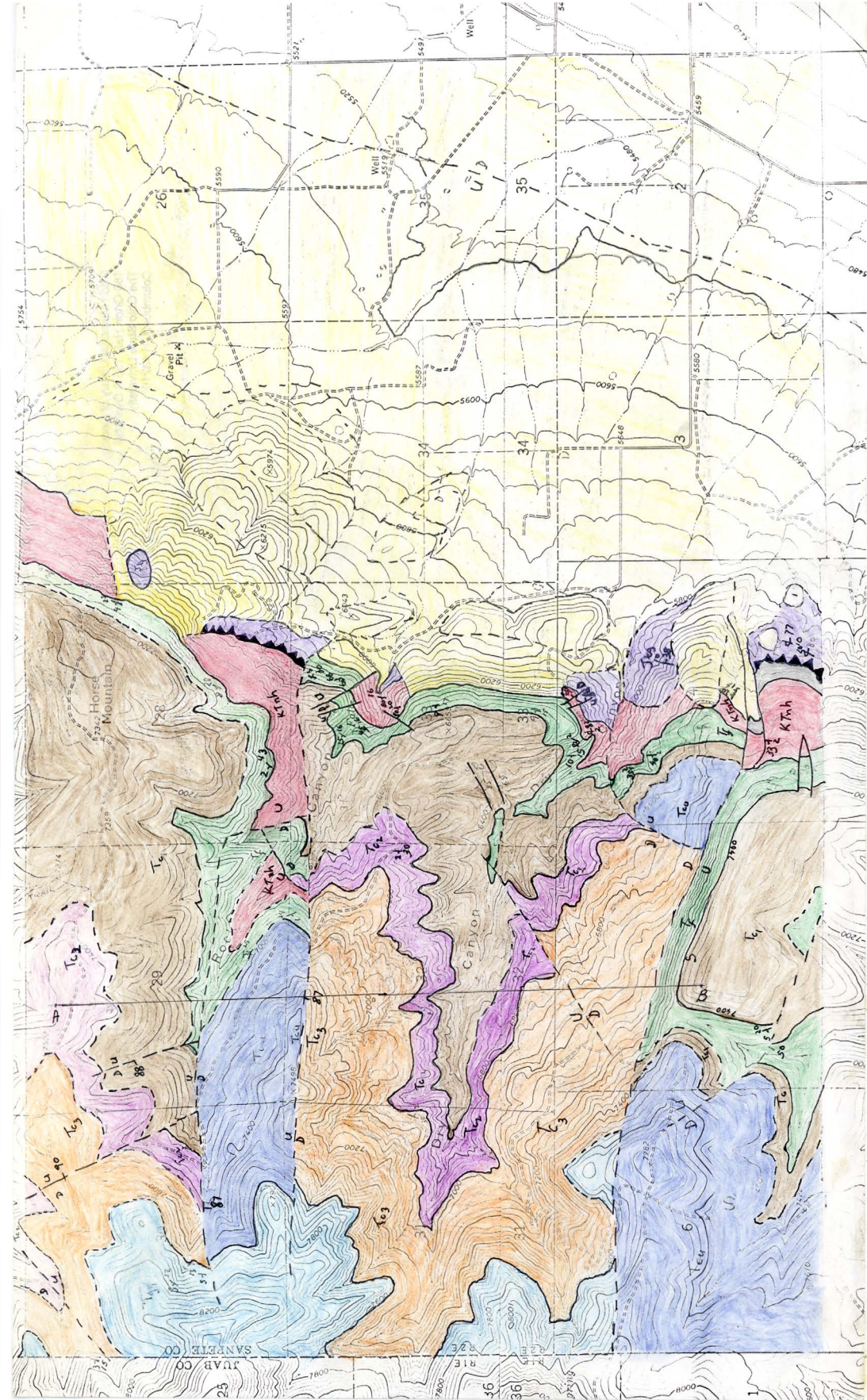
STRATIGRAPHY of DRY CANYON AREA

Age	Thickness (in ft)	Formation	Description
QUATERNARY			
			Floats of platy, grayish to yellowish limestone, sandy and silty
			Limestone, gray, weathers to yellow, with few algal heads at base
	939	GREEN RIVER	Thinly interbedded limestone, quartz sandstone, and siltstone cemented with calcite, varicolored
TERTIARY			Limestone, light gray-greenish, weathers yellow
			Mudstone, varicolored, thin beds
			Limestone, massive, light gray
			Mudstone and siltstone, shaly, brown contains fossil hash
			Mudstone, thin-bedded, calcareous, dark gray capped by yellow sandstone; contains fossil hash
TERTIARY	989	COLTON	Siltstone, thin-bedded, calcareous, yellow, with fragments of gastropod shells, interbedded with calcareous mudstone and limestone towards the base
TERTIARY	511	FLAGSTAFF	Limestone, interbedded with calcareous mudstone and siltstone, few dolostone beds at base; contains fossil shell fragments
CRETACEOUS TERTIARY	186	NORTH HORN	Muddy siltstone, silty mudstone and calcareous mudstone, in alternating thin conglomeratic (oncolitic) ss at base
CRETACEOUS	100	INDIANOLA	Conglomerate, tan, sandy, with angular unconformity at top
JURASSIC	850	TWIST GULCH	Siltstone, mudstone, and sandstone, in alternating thin beds. Siltstone and sandstone beds are friable; sandstone beds are mainly composed of smoky quartz; sorting is bimodal. Sandstone unit also shows crossbedding. Base of the formation is covered by alluvium in most places.

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MAP, CROSS SECTION AND EXPLANATION

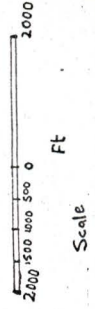
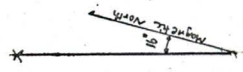


THE GEOLOGIC MAP of DRY CANYON AREA

EPHRAIM UTAH

by

JENKINS K. DORBOR

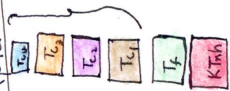


SYMBOLS USED:

- Geologic Contact
- - - Approximate Contact
- geol. or fault contact, projected beneath mapped units
- - - Fault located by aerial photos
- U - U fault - U upthrown side, downthrown side D
- Dip indicated
- Thrust fault; Sawtooth on upper plate
- Dip and strike

Cross Section along AB

Explanation

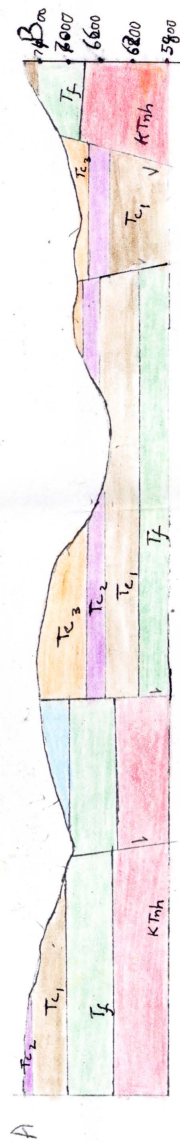


Units in Colton Fm, Tertiary

Flogstaff Fm, Tertiary

North Horn Fm, Cretaceous & Tertiary

Fault



Scale: 1/24000
No exaggeration

by
Jenkins K. Dorbor

Mar., 1971

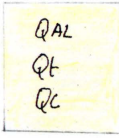
EXPLANATION OF MAP

Dry Canyon Area, Ephraim, Utah

CENOZOIC

MESOZOIC

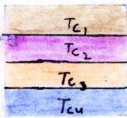
QUATERNARY (Recent)
TERTIARY (Eocene)
TERTIARY (Eocene)
TERTIARY (Paleocene/Eocene)
CRETACEOUS
CRETACEOUS
JURASSIC



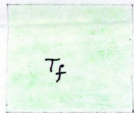
QAL: Quaternary Alluvium
Qt: Quaternary tereva blocks
Qc: Quaternary Colluvium



GREEN RIVER FORMATION



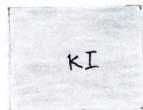
COLTON FORMATION



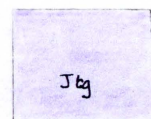
FLAGSTAFF FORMATION



NORTH HORN FORMATION



INDIANOLA FORMATION



TWIST GULCH FORMATION